Taxonomic and nomenclatural notes on the Eastern grey boxes (*Eucalyptus* ser. *Moluccanae* Chippendale, Myrtaceae) and the reinstatement of *Eucalyptus woollsiana* R.T.Baker

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Summary

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Key Words: Myrtaceae, Eucalyptus, Eucalyptus albens, Eucalyptus microcarpa, Eucalyptus moluccana, Eucalyptus pilligaensis, Eucalyptus woollsiana, Australia, Australian flora, taxonomy, nomenclature, identification keys

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Introduction

The Eastern grey box group (Eucalyptus ser. Moluccanae) was established by Chippendale (1988), who included four species, viz. E. moluccana Roxb., E. microcarpa (Maiden) Maiden, E. albens Benth. and E. pilligaensis Maiden. These species are commonly referred to as the "Eastern grey boxes" or the "Grey boxes". This group is defined by the grey scaly box-bark persistent on the trunk and sometimes on larger branches; deciduous bark shedding in long ribbons; the adnate anthers; the presence of two opercula, both held until maturity (and hence operculum scar absent); mature buds with one or more longitudinal ridges, sometimes extending to the operculum; stamens all fertile; the fruits often slightly or distinctly barrel-shaped, i.e. broadest below the distal end of the fruit; and the fruiting valves deeply enclosed.

Brooker (2000) altered the rank and circumscription of the group. His *Eucalyptus* supraspecies *Moluccanae* (Chippendale) Brooker included nine species, viz. *E. moluccana*, *E. microcarpa*, *E. pilligaensis*, *E. albens*, *E. polybractea* R.T.Baker, *E. odorata* Behr, *E. viridis* R.T.Baker, *E. persistens* L.A.S.Johnson & K.D.Hill and *E. lansdowneana* subsp. *albopurpurea* Boomsa (now *E. albopurpurea* (Boomsa) D.Nicolle). The recently named *Eucalyptus castrensis* K.D.Hill (Hill & Stanberg 2002) and *E. aenea* K.D.Hill (Hill 1997) could reasonably be added to this group.

This paper deals with the four species of ser. *Moluccanae* of Chippendale (1988). These are the only species known as the "Eastern grey boxes". With the exception of *Eucalyptus odorata*, the other species included by Brooker (2000) are either mallees or are geographically disjunct from occurrences of Eastern grey boxes.

Clinal variation in eucalypts: There are a great number of *Eucalyptus* species that are relatively uniform and can always be distinguished from their relatives, e.g. *E. tenuipes* (Maiden & Blakely) Blakely & C.T.White, *E. longifolia* Link, *E. robusta* Sm. While identification of these species may not always be easy, they do not appear to intergrade with any other species.

However, eucalyptologists have long acknowledged that for other species there is extensive intergradation or clinal variation within and between them. For instance,

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Eucalyptus populnea F.Muell. and *E. brownii* Maiden & Cambage intergrade extensively in central Queensland (Pedley 1969), and identification in the overlap zone is achieved by applying arbitrary rules such as the lengthbreadth ratio of adult leaves. *Eucalyptus saligna* and *E. botryoides* intergrade south of Sydney (Passioura & Ash 1993) and a number of species pairs in the eastern Red gum group (*Eucalyptus* subser. *Erythroxyla*) intergrade extensively (Brooker & Slee 2000).

For the Eastern grey box group, numerous botanists e.g. Maiden (1921), Blakely (1934), Pryor & Johnson (1971), Gillison (1976), Hill (1991), Brooker & Slee (1996), Brooker & Kleinig (2006), Nicolle (2006) have acknowledged that there is intergradation or clinal variation between its member species. The PhD thesis of Gillison (1976) was an attempt to classify the Eastern Grey box taxa using numerical taxonomic techniques. He proposed a number of subspecies for *E. moluccana*, but these were never validly published.

The range of variation exhibited by this group is too great for the recognition of only one species, but when four species are recognised (as is currently the case), the species are very difficult to define and consistently identify. Previous reported differences between species have often been vague. For instance, Brooker et al. (1984) said that Eucalyptus moluccana "differs from the other Grey boxes E. microcarpa and E. pilligaensis in the broader leaves, usually less rough bark and taller habit". Hill (1991) keyed Eucalyptus moluccana from E. microcarpa by the bud length (not borne out in the descriptions) and the width of the adult leaves.

My field investigations have clearly indicated that there is clinal variation within and across all taxa, at least in some parts of their range. On the other hand, there are clear and distinct morphological changes in some areas.

In view of the poorly defined differences between taxa and the intergradation between them, one could argue that three species only (*Eucalyptus moluccana, E. albens* and *E. woollsiana*) should be recognised, with the typical form of *E. microcarpa* being merged with *E. moluccana*, and the southern New South Wales, Victorian and South Australian populations of *E. microcarpa* included with either *E. woollsiana* or *E. odorata*. However, I have maintained the status quo for *Eucalyptus microcarpa* here because of my lack of field knowledge of the group in Victoria and South Australia.

As with many other groups within *Eucalyptus*, the identification to species of herbarium specimens of Eastern grey boxes can be difficult. The juvenile leaves, so useful in the classification of *Eucalyptus* spp., are only rarely represented in herbarium material. It therefore falls to field observations or seedling trials to gather information on the juvenile leaf morphology.

Materials and methods

The data and descriptions presented here are based largely on a morphological study of herbarium specimens at BRI and NSW, as well as type material at K and MEL. This has been supported by extensive field examinations of Eastern grey box populations by the author throughout much of Queensland and New South Wales over the last twenty years. All measurements are based on dried herbarium specimens.

Taxonomy

Eucalyptus series **Moluccanae** Chippendale, *Fl. Australia* 19: 501 (1988). **Type:** *E. moluccana* Roxb.

Trees, single-trunked. Persistent bark scaly or finely tessellated, uniformly grey or mottled with various shades of grey; deciduous bark grey, white, yellow or coppery, somewhat shiny, shedding in long ribbons. Terminal paniculate inflorescences and axillary simple inflorescences often both present. Mature buds with one or more longitudinal ridges, sometimes extending to the opercula. Opercula two, both shedding at anthesis, operculum scar absent. Stamens all fertile; filaments white, inflexed; anthers adnate. Fruits with deeply enclosed valves.

Key to species of the Eastern grey box group

1 1.	 Fruits cupular to obconical, 2.3–4.2 mm long; juvenile leaves linear to lanceolate (5–20 times longer than broad); adult leaves 5.5–15 times longer than broad . Fruits slightly to distinctly barrel-shaped, sometimes cupular, (3–)4–13 mm long; juvenile leaves ovate to orbicular (1.4–5 times longer than wide); adult leaves 2.2, 6.4 times longer than broad 	.1. E. woollsiana
	wide), adult leaves 2.9–6.8 times longer than broad	
2 2.	Buds, fruits and branchlets glaucous; fruits 8–13 mm long Buds, fruits and branchlets not glaucous; fruits (3–)4–7.5 mm long	2. E. albens
3	Juvenile leaves broadly-ovate to almost orbicular, 1.4–2.8 times longer than broad; fruits $4-7.5 \times 3.5-6$ mm; adult leaves $2.1-5(-6)$ cm wide	
		3. E. moluccana
3.	Juvenile leaves ovate to broadly lanceolate, 2.5-5 times longer than broad; fruits $(3-)4-6.5 \times 3-5.5$ mm; adult leaves $1.4-3.4$ cm wide	4. E. microcarpa

1. Eucalyptus woollsiana R.T.Baker, *Proc. Linn. Soc. New South Wales* 25: 684 (1900, publ. 1901). Type citation: "Girilambone, Cobar, and Trangie (W. Baeuerlen); Nyngan and Murga (R. H. Cambage)". Type: New South Wales. Nyngan, June 1900, *R.H.Cambage s.n.* (lecto [here designated]: NSW321382).

Eucalyptus odorata var. woollsiana Maiden, Crit. Revis. Eucalyptus 2: 32 (1910). **Types:** Mount Boppy, near Cobar, J.L.Boorman; Girilambone to Condobolin, W.Baeuerlen; Condobolin, R.H.Cambage; Gilgandra, R.H.Cambage; on the plains near Baradine, W.Forsyth; 18 miles from Dubbo, W.Forsyth; Castlereagh River, W.Woolls; Narrabri, J.H.Maiden; Narrabri West, J.L.Boorman; Pilliga, J.L.Boorman; Denman, W.Heron (all syn: NSW).

Eucalyptus pilligaensis Maiden, *J. & Proc. Roy. Soc. New South Wales* 54: 163 (1920), **syn. nov. Type:** New South Wales. Narrabri, November 1899, *J.H.Maiden s.n.* (holo: NSW [2 sheets; NSW322074 & NSW322075]).

Illustrations: Brooker & Kleinig (2004: 323), as *E. pilligaensis*; Brooker & Kleinig (2006: 221), as *E. pilligaensis*.

Bark persistent on trunk to base of primary branches, mid- to dark-grey, smooth bark grey to yellow or coppery. Juvenile leaves linear to broadly-lanceolate, dull but not glaucous, $8.5-13 \times 0.7-2.5$ cm, 5-15 times longer than broad. Adult leaves narrow-lanceolate to lanceolate, \pm glossy, 9–13 × 0.8–2 cm, 5.5–15 times longer than wide, straight or slightly falcate. Inflorescence 5–7-flowered, axillary or in short panicles. Peduncles 2–7 mm long, \pm terete. Pedicel angular, 1.5–5 mm long, angles extending to base of hypanthium and sometimes onto operculum. Mature buds broadly ellipsoid, not glaucous, 3.3–5.5 mm long, 2–2.6 mm wide. Operculum conical, about same length as hypanthium, acute. Fruiting pedicel 1–3.5 mm long. Fruits cupular, not glaucous, 2.3–4.2 mm long, 2.7– 3.6 mm wide, disc descending, valves 3 or 4.

Additional selected specimens examined: Queensland. MARANOA DISTRICT: 11 km NE of Mt Owen Homestead, c. 140 km N of Mitchell, Nov 2006, Bean 25849 (BRI); 25 miles [40 km] from Ogilby corner towards Womblebank, Apr 1975, Brooker B4889 (BRI). DARLING DOWNS DISTRICT: c. 7.4 km W on Mt Myrtle road from Miles - Wandoan road (Leichhardt Highway), Oct 1993, Slee 3466 (BRI, CANB); 21 miles [34 km] ENE of Chinchilla, Jun 1968, Johnston 585 (BRI, CANB); Yuleba S.F., 46 km by road W of Condamine and c. 14 km S of Condamine Highway, Apr 2004, Thomas 2598 (BRI); Coomrith Station near Meandarra, Jul 1969, Webb 8303 (BRI); Mingimarny S.F. 131, 20 km S of Milmerran, Apr 1995, Forster PIF16450 (BRI); Bracker S.F., Catfish Creek (south branch), 5 km due W of Texas - Inglewood road, Oct 1994, Sparshott KMS343 (BRI); 1 km E of Kurumbul, Feb 1996, Bean 9825 (BRI). New South Wales. North Western Plains: c. 30 km SE of Boggabilla, May 1986, King 32 (NSW); adjacent to "Currotha" Homestead, c. 80 km W of Moree, Jan 1999, Wannan 1056 (NSW); Cuttabri, Aug 1919, Jensen s.n. (NSW); between Narrabri and Wee Waa, south of Namoi River, Feb 1964, Walker s.n. (NSW); 1.2 km along Cherry road, 27 km S of Narrabri, Mar 2008, Bean 27749 (BRI, NSW); Bilambil, 9 miles [15 km] W of

Baradine, Mar 1951, Constable s.n. (NSW); 4.6 km E of Paisley Junction, c. 50 km SSW of Nyngan, Mar 2008, Bean 27683 (BRI, NSW). SOUTH WESTERN PLAINS: c. 10 km NW of Five Ways, about 50 km SSW of Nyngan, Mar 2008, Bean 27690 (BRI, CANB); 47 km S of Five Ways, towards Condobolin, Mar 2008, Bean 27692 (BRI); 19 km from Nymagee on Condobolin road, Sep 1992, Hill 4270 (NSW); 24.7 km NNW of Condobolin, on road to Cobar, Mar 2008, Bean 27699 (BRI, CANB, NSW). CENTRAL WESTERN SLOPES: 9.2 km from Parkes, on road to Wellington, Mar 2008, Bean 27704 (BRI); Wongajong, near Forbes, Aug 1904, Holdsworth s.n. (NSW); Ardlethan, Nov 1917, Boorman s.n. (NSW). SOUTH WESTERN SLOPES: SW side of Sturt Hwy at stockpile site (c. 2km SE of Sandigo), 25.2 km SE of Narrandera, Nov 2000, Jobson 6844 (NSW).

Distribution and habitat: Eucalyptus woollsiana is widespread from southern Queensland (e.g. Injune, Chinchilla) to southern inland New South Wales (**Map** 1). The actual southern extent is blurred by intergradation with *Eucalyptus microcarpa*. In Queensland and northern New South Wales, it frequently grows on flat land with brigalow (*Acacia harpophylla*) or belah (*Casuarina cristata*), on heavy black clay soils. Further south, it tends to grow on undulating terrain with other eucalypts, notably *Eucalyptus*



Map 1. Distribution of *Eucalyptus woollsiana*

populnea. The soils, while still clayey, vary in colour and texture.

Typification: There has been considerable confusion about the typification and application of this name since its publication on 20^{th} May 1901.

Maiden (1921: 202) wrote "I have received, in response to my request for types [of *E. woollsiana*], specimens labelled by Mr. Baker. Condobolin and Girilambone to Condobolin." The two sheets mentioned by Maiden, namely "Condobolin" (NSW118270) "Girilambone and to Condobolin" (NSW118269) both belong to a taxon in the Eastern grey box group, allied to E. moluccana and E. microcarpa. Gillison (1976) and Chippendale (1988) accepted Baeuerlen's "Girilambone to Condobolin" specimen as the type of *E. woollsiana*.

However, Article 9.10 of the International Code for Botanical Nomenclature states that the lectotype must be chosen from amongst the syntypes, if such exist. Baker's protologue corresponds to a minimum of five specimens, some collected by W. Baeuerlen and some by R. Cambage. It is apparent that only three gatherings matching the protologue details are now extant at NSW, where Baker's herbarium is now housed. They are 1. Girilambone, March 1900, *Baeuerlen 2578*; 2. Girilambone, January 1900, *Baeuerlen s.n.*; and 3. Nyngan, June 1900, *R.H. Cambage s.n.*

Both of the Baeuerlen gatherings are referrable to *Eucalyptus viridis* R.T.Baker. Only the Cambage gathering is referrable to the species of tree-form with the short pedicels and lanceolate juvenile leaves. Article 9.17 of the Code states that when the synytpes comprise more than one taxon, the chosen lectotype must be in accordance with the taxon that best matches the description given in the protologue. In this case, the species of tree-form with short pedicels and lanceolate juvenile leaves is clearly the intended species. Therefore, the Cambage specimen at NSW is designated as the lectotype.

Notes: It is not surprising that Baker and later workers confused herbarium material of *Eucalyptus woollsiana* and *E. viridis*.

Both species have narrow green leaves, operculum scar, small fruits, and no predominantly axillary inflorescences. In the herbarium, the typical form of E. viridis may be distinguished by the longer and more attenuate buds, the broader fruits, the slightly narrower adult leaves, and the longer pedicels on both buds and fruits. When juvenile leaves are present, these provide a further differentiation – those of *E. woollsiana* are lanceolate near the type locality, whereas E. viridis juveniles are linear. In the field, there is little likelihood of confusion: *E. woollsiana* is invariably a tree to 20 metres high. E. viridis is invariably a mallee to 8 m which can occur in the same general area as E. woollsiana (e.g. S of Nyngan), but is never associated with it.

Gillison (1976) wrote "the type locality now appears to be devoid of box trees of the type described by Baker, particularly near Girilambone where *E. viridis* is common." He then went on to postulate that all the *E. woollsiana* trees near Girilambone had been destroyed for pit-props and railway sleepers in the early 20th century. It is true that *E. woollsiana* (as to lectotype) does not now occur in the Girilambone area, but I contend that it was never there in the first place. Baker's citation of 'Girilambone' in the protologue of *E. woollsiana* is based on specimens of *E. viridis*.

Blakely (1934) and Johnston & Marryatt (1965) accepted Eucalyptus woollsiana as a distinct species. Hall et al. (1970) treated E. woollsiana and E. microcarpa on the same page, because they "are so closely related", and distinguished them only on the shape of the juvenile and adult leaves. Pryor & Johnson (1971) foreshadowed the reduction of E. microcarpa to a subspecies of E. woollsiana, but this did not occur. Brooker & Kleinig (1983) treated E. microcarpa as an accepted species with the notation in brackets "includes E. woollsiana". Brooker et al. (1984) repeated this statement. Since then, E. woollsiana has been relegated to synonymy with E. microcarpa, despite the fact that woollsiana is the earlier name by 20 years.

The acceptance of *Eucalyptus microcarpa* over E. woollsiana appears to stem from Gillison (1976) who wrote "For the present ... I cannot accept E. woollsiana as a valid species. The taxonomic position of the lectotype is not clear. I have examined the specimen 'Woollsiana No. 1' from Girilambone to Condobolin (W. Baeuerlen, Sept. 1900) which is a mixture of at least two taxonomically distinct specimens". It is perhaps true that the branchlet at the far left hand side of that specimen belongs to another gathering or taxon, but as it is sterile, it is difficult to say. Certainly all of the fertile branchlets are from the same taxon, and are consistent with a single gathering.

Gillison (1976) rejected *Eucalyptus woollsiana* with the following statement: "The retention of *E. woollsiana* as a species can serve no useful purpose, neither is it useful to consider it as 'geminate' with *E. microcarpa* in view of its intergradations with other taxa, in particular *E. pilligaensis*. Under the circumstances I consider the lectotype specimen is part of a hybrid swarm."

It is indisputable that there is clinal variation occurring between members of the Eastern grey box group, but in the Nyngan area the Grey box taxon is quite uniform in morphology. Therefore it is difficult to see how the lectotype could be interpreted as "part of a hybrid swarm", and it is not acceptable to invalidate *Eucalyptus woollsiana* on this basis.

Eucalyptus woollsiana does not have the ovate juvenile leaves and the rather broad adult leaves that characterise typical E. microcarpa, and the fruits of E. woollsiana are smaller and cupular to obconical in shape. Hence they cannot be considered synonymous. However, E. woollsiana populations occurring near Nyngan (the type area) have all the features of E. pilligaensis. Maiden distinguished E. pilligaensis on the basis of its narrow "sucker leaves" and small fruits, but these are also the salient features of E. woollsiana. They are here considered synonymous. There is variation in the width of juvenile leaves within E. woollsiana; populations from the Yelarbon-Inglewood area of Queensland have linear juvenile leaves, while the lanceolate juveniles seen around Narrabri (type locality of *E. pilligaensis*) are very similar to those encountered between Nyngan and Condobolin (near the type locality of *E. woollsiana*).

2. Eucalyptus albens Benth., *Fl. Austral.* 3: 219 (1867); *E. hemiphloia* var. *albens* (Benth.) Maiden, *Forest Fl. New South Wales* 1: 131 (1904). **Type citation:** "NSW. Macquarie River, *A. Cunningham*; New England, 'White Gum', *C. Stuart*; between Alford's and the Range, 'Box', *Leichhardt*. Victoria. Poor plains, between Ten-mile Creek and Broken River, 'White Box', *F.Mueller*". **Type:** [New South Wales]. New England, undated, *C.Stuart s.n.* (lecto [here designated]: K000347583; isolecto: MEL73265).

Illustrations: Brooker & Kleinig (2004: 324); Boland *et al.* (2006: 465); Brooker & Kleinig (2006: 223).

Trunk and all primary branches rough-barked, pale grey; smooth bark white to grey. Juvenile leaves broadly ovate to orbicular, glaucous, $9-15 \times 4-10$ cm, 1.4-2.6 times longer than broad. Adult leaves lanceolate to ovate, 7.5- $15 \times 1.6-3.8$ cm, 3.4-8.4 times longer than wide. Umbels 7–9-flowered, young buds and pedicels very angular, mature buds with one or more longitudinal ridges, sometimes extending to the operculum, pedicels 2–5 mm long; mature buds broadly ellipsoidal, glaucous, $10-14 \times 4-6$ mm; operculum about same length as hypanthium; fruits barrelshaped, glaucous, 8–13 mm long, 5.3–8 mm across, pedicels 0–13 mm long.

Additional selected specimens examined: South Australia. Along roadside to Bangor, 4.8 km S of Melrose (c. 60 km SE of Port Augusta), May 1977, Boomsma 235 (NSW); S of Mt Remarkable, Jan 1970, Brown s.n. (NSW). Queensland. DARLING DOWNS DISTRICT: 6.1 miles N of Yamsion on Bunya Mountains road, May 1961. Smith 11363 (BRI); 3.3 km E of Kulpi, towards Haden, Jul 2002, Bean 19085 (BRI); Maryvale, Mar 1953, Blake 19129 (BRI); Warwick - Inglewood road, W of Karara, Cunningham Highway, May 1994, Grimshaw G661 (BRI); near the summit of Mt Malakoff at the junction of Monday Creek and the Severn River, SW of Stanthorpe, Apr 1988, Thomas 284 (BRI). New South Wales. NORTH WESTERN SLOPES: Warialda, Jun 1970, Kleinschmidt 106 (BRI); 37.7 km from Barraba, towards Gunnedah, Dec 1995, Bean 9390 (BRI); Oxley Park, Tamworth, Jun 1985, Hosking s.n. (NSW). NORTHERN TABLELANDS: 6.2 km W of Baldersleigh, between Armidale and Bundarra,

Dec 2008, Bean 28406 (BRI). CENTRAL WESTERN SLOPES: 9 km NW of Cassilis along the road to Coolah, Sep 1988, Greuter 20615 (NSW); Merric property on ridge c. 1.5 km W of homestead, May 1988, Hill 2793 (BRI); 3.5 km SSE of Grenfell towards Young, Apr 1974, Chippendale 956 (NSW), CENTRAL TABLELANDS: Cadia, c. 24 km S of Orange, Nov 1991, Rodd 6248 (NSW). South WESTERN SLOPES: c. 5 km directly east of Bethungra and 31 km directly ENE of Junee, Oct 1991, Parris 9938 (NSW). SOUTHERN TABLELANDS: Wee Jasper Creek, Tumut, Nov 1949, Rodway 15094 (NSW); Jacobs Ladder, Snowy Mountains, Tongaroo River, Feb 1960, Raeder-Roitzsch s.n. (NSW). Victoria. Warby Range, 1.5 km S of Glenrowan, Apr 1985, Briggs 1862 (NSW); 16.2 km ESE Yarrawonga towards Rutherglen on Murray Valley Highway, Jul 1975, Chippendale 1394 (BRI, NSW); 1.5 miles [2.4 km] N of Ballantyne Gap towards Snowy River, Sep 1975, Brooker 4975 (BRI, NSW); Tongio Gap, Oct 1977, Carr 2220 (BRI, NSW).

Distribution and habitat: Eucalyptus albens has a limited occurrence in Queensland, confined to higher altitudes on heavy soils west of the Great Dividing Range, and south from the Bunya Mountains. It is however, very common in a broad band on the western slopes of the Great Divide in New South Wales, in northern Victoria, and near Melrose in South Australia (**Map 2**). It inhabits flat to undulating terrain with fertile clayey soils.

Notes: Johnson (1962) discussed at length the authorship of *Eucalyptus albens*, and I



Map 2. Distribution of Eucalyptus albens

endorse his conclusion that Bentham should be attributed as the sole author of the name.

Eucalyptus albens overlaps in distribution with *E. moluccana*, usually without intergradation, although Hill (1991) mentioned that it intergrades with *E. moluccana* in the upper Hunter Valley. According to Brooker & Slee (1996), *E. albens* intergrades with *E. microcarpa* in eastern and central parts of Victoria.

Typification: The lectotype of *Eucalyptus albens* consists of a single branchlet bearing adult leaves and several umbels of flowers. On the label is written "Eucalyptus dealbata A.C./ New England, N.S.W./ C. St." The isolectotype at MEL has two branchlets bearing adult leaves, mature buds and open flowers, while there are loose mature fruits in a fragment packet.

3. Eucalyptus moluccana Roxb., *Fl. Indica*, 2nd edition, 2: 2 (1832). **Type:** cultivated at Amboyna, *s.dat.*, *C. Smith s.n.* (iso: BM000944059 [image at BRI]), *fide* Johnson (1962).

Eucalyptus hemiphloia F.Muell. ex Benth., *Fl. Austral.* 3: 216 (1867). **Type:** Queensland. Moreton Bay, *F.Mueller s.n.* (syn: MEL); New South Wales. Parramatta, *W.Woolls s.n.* (syn: MEL).

Illustrations: Brooker & Kleinig (2004: 321) and (2004: 322, as *E. microcarpa*); Boland *et al.* (2006: 461); Brooker & Kleinig (2006: 222); Melzer & Plumb (2007: 240).

Bark persistent on trunk to base of primary branches, mid- to dark-grey, smooth bark white to grey. Juvenile leaves broadly ovate to almost orbicular, dull but not glaucous, 10-15 \times 3.5–10 cm, 1.4–2.8 times longer than broad. Adult leaves lanceolate to broadly-lanceolate, $8-15 \times 2.1-5(-6)$ cm, 2.9-4.5 times longer than wide. Umbels 5-9(-11)-flowered, young buds and pedicels very angular, mature buds with one or more longitudinal ridges, sometimes extending to the operculum, pedicels 2-5 mm long; mature buds broadly ellipsoidal, not glaucous, $6-8.5(-9.5) \times 3-4.5$ mm; operculum about same length as hypanthium; fruits usually at least slightly barrel-shaped, occasionally cupular or obconical, not glaucous, 4–7.5 mm long, 3.5–6 mm across, pedicels 0.5–5 mm long.

Additional selected specimens examined: Queensland. COOK DISTRICT: 12.5 km E of Bakerville towards Herberton, Oct 1976, Kleinig DK315 (BRI). NORTH KENNEDY DISTRICT: 0.5 km S of Herberton on road to Wondecla, Aug 1984, Clarkson 5483 (BRI); 10 miles [16 km] NE of 'Valley of Lagoons' Station, Jul 1953, Lazarides 3761 (BRI); Near South Pinnacle, 25 km SW of Townsville, Sep 1992, Bean 5069 (BRI). SOUTH KENNEDY DISTRICT: Scawfell Island N.P., 50 km ENE of Mackay, Nov 1986, Batianoff 5560 (BRI, NSW); 21 km from Eungella, towards Eungella Dam, Feb 2003, Bean 20020 (BRI, NSW). PORT CURTIS DISTRICT: 14.8 km SW of Yeppoon towards Rockhampton, Sep 1974, Chippendale GC1122 (BRI, NSW); 37 km NW of Gladstone, S.F. 60 Rundle Range, Aug 1989, Gibson TOI685 (BRI, NSW); 12.8 km NE of Bororen, Apr 1970, Boyland 1515 (BRI). LEICHHARDT DISTRICT: 23.5 km E of Dingo, Brooker 10228 (BRI, NSW); Buckland Tableland, E of Van Dyke Creek via Springsure, Apr 1988, Bean 795 (BRI, NSW). BURNETT DISTRICT: 3 km S of Kalpowar along road to Monto, May 1977, Crisp 2684 (BRI); 28 miles [45 km] S of Goomeri towards Nanango, Aug 1972, Brooker 3751 (BRI). WIDE BAY DISTRICT: 3 km SSE of Tiaro on Bruce Highway, Sep 1974, Chippendale GC1141 (BRI, NSW); Moy Pocket Road, 3km SE of Brooloo, Apr 1993, Bean 6004 (BRI). DARLING DOWNS DISTRICT: 15 km SSE of Leyburn, Jan 1973, Pedley 4065 (BRI); Graymare W of Warwick, Jul 1951, Blake 18778 (BRI, NSW). MORETON DISTRICT: North of Somerset Dam, Feb 1939, Blake 13958 (BRI, NSW); Dinmore, Mar 1887, Bailey s.n. (BRI, NSW). New South Wales. North COAST: Richmond Range at Busbys Flat and Mallanganee, Dec 1920, Rummery s.n. (NSW); 2.1 km along Orara Way from Grafton - Nymboida road, Nov 2004, Johnston 1443 (NSW). NORTHERN TABLELANDS: 10.4 miles [16.6 km] east of Armidale, Feb 1973, Brooker 3907 (BRI, NSW). NORTH WESTERN SLOPES: 1 km W of Tamworth Airport, Jan 1975, Johnson 7885 (NSW). CENTRAL WESTERN SLOPES: 18.4 km SE Murrurundi on New England Highway, Apr 1975, Chippendale 1229 (BRI, NSW); 16.4 km from Scone towards Merriwa, Nov 1990, Brooker 10631 (BRI, CANB, NSW). CENTRAL COAST: 6.8 km from Glenorie - Wisemans Ferry road towards Sackville, May 1974, Chippendale 1015 (BRI, NSW); Off main Southern Road, Cabramatta, Sep 1917, Austin s.n. (NSW). SOUTH COAST: 1.8 km N of Klimpton on Princes Highway, between Parma and Currambene Creeks, Sep 1975, Brooker 4926 (BRI, NSW).

Distribution and habitat: In New South Wales, *Eucalyptus moluccana* occurs from Port Jervis in the south, and as far west as the western slopes of the New England Tableland. In Queensland, it grows mainly within 150 km of the coast, but extends further inland around Durong, Taroom, and Duaringa. It occurs as far north as Herberton, and the most westerly occurrence is on Consuelo Tableland in the Carnarvon National Park (**Map 3**). The soils

are typically heavy clays (though sometimes sandy on the surface), and it is most often found on alluvial situations or lower slopes of hills, but sometimes on basaltic ridges.

Notes: The fruits borne on *Eucalyptus moluccana* around the Consuelo Tableland in central Queensland have an average length of 7.0 mm. This is much longer than elsewhere in Queensland, although comparable sizes are found on the central coast and northern tablelands of New South Wales. In other parts of Queensland, the average fruit length varies from 4.8 mm (Le, Pc, Bn districts) to 5.8 mm (Mo, Dd, Sk districts).

Typification: The isotype of *Eucalyptus moluccana* at BM consists of a sprig bearing



Map 3. Distribution of *Eucalyptus moluccana*

a few leaves and a few inflorescences on a second small branchlet. These inflorescences bear open flowers and a single mature bud. The combination of the apparently compound inflorescences, the leaf shape and venation, the lack of glaucousness and the bud shape provide strong evidence to support Johnson's claim that *Eucalyptus moluccana* is synonymous with *E. hemiphloia*.

4. Eucalyptus microcarpa (Maiden) Maiden, *Crit. Revis. Eucalyptus* 6: 438 (1923); *E. hemiphloia* var. *microcarpa* Maiden, *Forest Fl. New South Wales* 1: 131 (1904). **Type:** New South Wales. Gulgong, April 1904, *J.H.Maiden & J.L.Boorman s.n.* (holo: NSW).

Illustrations: Jones & Jones (1999: 108); Boland *et al.* (2006: 463); Brooker & Kleinig (2006: 220).

Bark persistent on trunk to base of primary branches, or sometimes rough bark extending to the medium and small branches, mid- to dark-grey; smooth bark grey to yellow or coppery. Juvenile leaves ovate to broadly lanceolate, dull but not glaucous, 9–16 \times 1.8-6 cm, 2.5-5 times longer than broad. Adult leaves lanceolate to broadly-lanceolate, $7-15 \times 1.4-3.4$ cm, 3.3-6.8 times longer than wide. Umbels 5-7-flowered, young buds and pedicels very angular, mature buds with one or more longitudinal ridges, sometimes extending to the operculum, pedicels 2-4 mm long; mature buds broadly ellipsoidal, not glaucous, $4.5-8 \times 1.8-4$ mm; operculum about same length as hypanthium; fruits usually at least slightly barrel-shaped, occasionally cupular or obconical, not glaucous, (3-)4-6.5mm long, 3-5.5 mm across, pedicels 0.5-4 mm long.

Additional selected specimens examined: South Australia. Flinders Range, Mt Remarkable foothills, Melrose, Sep 1946, Blake 16927 (BRI); Braeside, 18 km S of Shepherds Hill Reserve O'Halloran Hill, Oct 1968, Boomsma s.n. (NSW); 20 km N of Frances towards Bordertown, Mar 1995, Brooker 12165 (NSW). Queensland. MARANOA DISTRICT: Mt Brandon, Apr 1936, Blake 11145 (BRI); 9.2 km from Mungallala towards Mitchell, Apr 1986, Bean 428 (BRI, NSW); 7.8 km E of Mungallala on Charleville – Mitchell road, Jul 1989, Blaxell 89007 (BRI, NSW); 45 km from Mitchell towards Bollon, Mar 2001, Bean 17545 (BRI); Murphey Creek, 3 km E of Cedarilla – Megine road, Jul 1981, Neldner & Thomas 383 (BRI). New South Wales. CENTRAL WESTERN Bean, Eastern Grey Boxes

SLOPES: Dunedoo - Merrygoen road, Aug 1950, Johnson s.n. (NSW); Boomley to Caratel, Aug 1950, Johnson s.n. (NSW); Wollar, c. 30 miles [48km] N of Rylstone, Sep 1948, Constable s.n. (NSW); 23.2 km NNE of Marsden on Newell Highway, Apr 1974, Chippendale 950 (BRI, NSW); SW of West Wyalong, Blue Mallee S.F., Apr 1992, Sivertsen 1399 (NSW). South Western Slopes: 19.1 km NNE of Wagga Wagga on Olympic Highway, Apr 1974, Chippendale 929 (BRI, NSW); Mooney Swamp Road, NE of Deniliquin, Aug 1992, Porteners 920800 (NSW); between Walbundrie & Henty, Oct 1967, Hall 29 (NSW). Victoria. Near Pyramid Creek, 14.3 km W of Cohuna towards Kerang, Jul 1975, Chippendale GC1389 (BRI, NSW); NE side of Arnold Road, 7.1 km SE of Inglewood, Aug 1995, Jobson 3695 (BRI, NSW); c. 8 km south of Benalla on Midland Highway; adjacent to Warrenbayne S.F., Aug 1994, Brooker 11973 (NSW); 5 km W of Edenhope on Naracoorte road, Mar 1986, Hill 1684 (NSW); Melbourne area, Melton South, 100-200 metres E from Melton Railway Station, Feb 1991, Stajsic 174 (NSW).

Distribution and habitat: Eucalyptus microcarpa, as currently circumscribed, is widespread from the central western slopes of New South Wales (south from Dunedoo and Gulgong) and in northern, western and central Victoria and into South Australia. There is also a limited occurrence in the Mitchell area of southern Queensland (**Map 4**). It occurs on ranges, hills and undulating rises in clay-loam soils.

Notes: Maiden established Eucalyptus hemiphloia var. microcarpa as a "small-



Map 4. Distribution of Eucalyptus microcarpa

fruited form", but when a large number of specimens are examined there is in fact no significant difference in fruit size between specimens identified as *E. moluccana* and those identified as *E. microcarpa*.

Eastern grey box populations in the Mitchell area of southern Queensland are tentatively included here in *Eucalyptus microcarpa*, as the juvenile leaves are too broad to be accommodated by *E. woollsiana* as currently circumscribed, and the habitat for the Mitchell populations (undulating rises and residuals) is rather different to the usual habitat for *E. woollsiana* in southern Queensland (*i.e.* clay plains).

In western Victoria and South Australia, *Eucalyptus microcarpa* has rough bark extending to the medium and small branches, and is often difficult to distinguish from *E. odorata* (Nicolle 2006).

Eastern grey box populations close to the type locality of *Eucalyptus microcarpa* are very close to *E. moluccana*, apparently differing only by the somewhat narrower juvenile leaves in *E. microcarpa*. Meanwhile, populations from southern inland N.S.W. and northern Victoria are closely allied to *E. woollsiana*.

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